

§ 53.35 Test procedure for Class II and Class III methods for $PM_{2.5}$ and $PM_{10-2.5}$.

(a) *Overview.* Class II and Class III candidate equivalent methods shall be tested for comparability of $PM_{2.5}$ or $PM_{10-2.5}$ measurements to corresponding collocated $PM_{2.5}$ or $PM_{10-2.5}$ reference method measurements at each of multiple field sites, as required. Comparability is shown for the candidate method when simultaneous collocated measurements made by candidate and reference methods meet the comparability requirements specified in this section § 53.35 and in table C-4 of this subpart at each of the required test sites.

(b) *Test sites and seasons.* A summary of the test site and seasonal testing requirements is presented in table C-5 of this subpart.

(1) *Test sites.* Comparability testing is required at each of the applicable U.S. test sites required by this paragraph (b). Each test site must also meet the general test site requirements specified in § 53.30(b).

(i) *$PM_{2.5}$ Class II and Class III candidate methods.* Test sites should be chosen to provide representative chemical and meteorological characteristics with respect to nitrates, sulfates, organic compounds, and various levels of temperature, humidity, wind, and elevation. For Class III methods, one test site shall be selected in each of the following four general locations (A, B, C, and D). For Class II methods, two test sites, one western site (A or B) and one midwestern or eastern site (C or D), shall be selected from these locations.

(A) Test site A shall be in the Los Angeles basin or California Central Valley area in a location that is characterized by relatively high $PM_{2.5}$, nitrates, and semi-volatile organic pollutants.

(B) Test site B shall be in a western city such as Denver, Salt Lake City, or Albuquerque in an area characterized by cold weather, higher elevation, winds, and dust.

(C) Test site C shall be in a midwestern city characterized by substantial temperature variation, high nitrates, and wintertime conditions.

(D) Test site D shall be in a northeastern or mid-Atlantic city that is

seasonally characterized by high sulfate concentrations and high relative humidity.

(ii) *$PM_{10-2.5}$ Class II and Class III candidate methods.* Test sites shall be chosen to provide modest to high levels of $PM_{10-2.5}$ representative of locations in proximity to urban sources of $PM_{10-2.5}$ such as high-density traffic on paved roads, industrial sources, and construction activities. For Class III methods, one test site shall be selected in each of the four following general locations (A, B, C, and D), and at least one of the test sites shall have characteristic wintertime temperatures of 0 °C or lower. For Class II methods, two test sites, one western site (A or B) and one midwestern or eastern site (C or D), shall be selected from these locations.

(A) Test site A shall be in the Los Angeles basin or the California Central Valley area in a location that is characterized by relatively high $PM_{2.5}$, nitrates, and semi-volatile organic pollutants.

(B) Test site B shall be in a western city characterized by a high ratio of $PM_{10-2.5}$ to $PM_{2.5}$, with exposure to windblown dust, such as Las Vegas or Phoenix.

(C) Test site C shall be in a midwestern city characterized by substantial temperature variation, high nitrates, and wintertime conditions.

(D) Test site D shall be in a large city east of the Mississippi River, having characteristically high sulfate concentrations and high humidity levels.

(2) *Test seasons.* (i) For $PM_{2.5}$ and $PM_{10-2.5}$ Class III candidate methods, test campaigns are required in both summer and winter seasons at test site A, in the winter season only at test sites B and C, and in the summer season only at test site D. (A total of five test campaigns is required.) The summer season shall be defined as the typically warmest three or four months of the year at the site; the winter season shall be defined as the typically coolest three or four months of the year at the site.

(ii) For Class II $PM_{2.5}$ and $PM_{10-2.5}$ candidate methods, one test campaign is required at test site A or B and a second test campaign at test site C or D (total of two test campaigns).

(3) *Test concentrations.* The test sites should be selected to provide ambient concentrations within the concentration limits specified in table C-4 of this subpart, and also to provide a wide range of test concentrations. A narrow range of test concentrations may result in a low concentration coefficient of variation statistic for the test measurements, making the test for correlation coefficient more difficult to pass (see paragraph (h) of this section, test for comparison correlation).

(4) *Pre-approval of test sites.* The EPA recommends that the applicant seek EPA approval of each proposed test site prior to conducting test measurements at the site. To do so, the applicant should submit a request for approval as described in § 53.30(b)(2).

(c) *Collocated measurements.* (1) For each test campaign, three reference method samplers and three candidate method samplers or analyzers shall be installed and operated concurrently at each test site within each required season (if applicable), as specified in paragraph (b) of this section. All reference method samplers shall be of single-filter design (not multi-filter, sequential sample design). Each candidate method shall be setup and operated in accordance with its associated manual referred to in § 53.4(b)(3) and in accordance with applicable guidance in “Quality Assurance Document 2.12” (reference (2) in appendix A to this subpart). All samplers or analyzers shall be placed so that they sample or measure air representative of the surrounding area (within one kilometer) and are not unduly affected by adjacent buildings, air handling equipment, industrial operations, traffic, or other local influences. The ambient air inlet points of all samplers and analyzers shall be positioned at the same height above the ground level and between 2 meters (1 meter for instruments having sample inlet flow rates less than 200 L/min) and 4 meters apart.

(2) A minimum of 23 valid and acceptable measurement sets of $PM_{2.5}$ or $PM_{10-2.5}$ 24-hour (nominal) concurrent concentration measurements shall be obtained during each test campaign at each test site. To be considered acceptable for the test, each measurement set shall consist of at least two valid ref-

erence method measurements and at least two valid candidate method measurements, and the $PM_{2.5}$ or $PM_{10-2.5}$ measured concentration, as determined by the average of the reference method measurements, must fall within the acceptable concentration range specified in table C-4 of this subpart. Each measurement set shall include all valid measurements obtained. For each measurement set containing fewer than three reference method measurements or fewer than three candidate method measurements, an explanation and appropriate justification shall be provided to account for the missing measurement or measurements.

(3) More than 23 valid measurement sets may be obtained during a particular test campaign to provide a more advantageous range of concentrations, more representative conditions, additional higher or lower measurements, or to otherwise improve the comparison of the methods. All valid data sets obtained during each test campaign shall be submitted and shall be included in the analysis of the data.

(4) The integrated-sample reference method measurements shall be of at least 22 hours and not more than 25 hours duration. Each reference method sample shall be retrieved promptly after sample collection and analyzed according to the reference method to determine the $PM_{2.5}$ or $PM_{10-2.5}$ measured concentration in $\mu g/m^3$. Guidance and quality assurance procedures applicable to $PM_{2.5}$ or $PM_{10-2.5}$ reference methods are found in “Quality Assurance Document 2.12” (reference (2) in appendix A to this subpart).

(5) Candidate method measurements shall be timed or processed and averaged as appropriate to determine an equivalent mean concentration representative of the same time period as that of the concurrent integrated-sample reference method measurements, such that all measurements in a measurement set shall be representative of the same time period. In addition, hourly average concentration measurements shall be obtained from each of the Class III candidate method analyzers for each valid measurement set and submitted as part of the application records.

(6) In the following tests, all measurement sets obtained at a particular test site, from both seasonal campaigns if applicable, shall be combined and included in the test data analysis for the site. Data obtained at different test sites shall be analyzed separately. All measurements should be reported as normally obtained, and no measurement values should be rounded or truncated prior to data analysis. In particular, no negative measurement value, if otherwise apparently valid, should be modified, adjusted, replaced, or eliminated merely because its value is negative. Calculated mean concentrations or calculated intermediate quantities should retain at least one order-of-magnitude greater resolution than the input values. All measurement data and calculations shall be recorded and submitted in accordance with § 53.30(g), including hourly test measurements obtained from Class III candidate methods.

(d) *Calculation of mean concentrations*—(1) *Reference method outlier test.* For each of the measurement sets for each test site, check each reference method measurement to see if it might be an anomalous value (outlier) as follows, where $R_{i,j}$ is the measurement of reference method sampler i on test day j . In the event that one of the reference method measurements is missing or invalid due to a specific, positively-identified physical cause (e.g., sampler malfunction, operator error, accidental damage to the filter, etc.; see paragraph (c)(2) of this section), then substitute zero for the missing measurement, for the purposes of this outlier test only.

(i) Calculate the quantities $2 \times R_{1,j}/(R_{1,j} + R_{2,j})$ and $2 \times R_{1,j}/(R_{1,j} + R_{3,j})$. If both quantities fall outside of the interval, (0.93, 1.07), then $R_{1,j}$ is an outlier.

(ii) Calculate the quantities $2 \times R_{2,j}/(R_{2,j} + R_{1,j})$ and $2 \times R_{2,j}/(R_{2,j} + R_{3,j})$. If both quantities fall outside of the interval, (0.93, 1.07), then $R_{2,j}$ is an outlier.

(iii) Calculate the quantities $2 \times R_{3,j}/(R_{3,j} + R_{1,j})$ and $2 \times R_{3,j}/(R_{3,j} + R_{2,j})$. If both quantities fall outside of the interval, (0.93, 1.07), then $R_{3,j}$ is an outlier.

(iv) If this test indicates that one of the reference method measurements in the measurement set is an outlier, the outlier measurement shall be eliminated from the measurement set, and the other two measurements considered valid. If the test indicates that more than one reference method measurement in the measurement set is an outlier, the entire measurement set (both reference and candidate method measurements) shall be excluded from further data analysis for the tests of this section.

(2) For each of the measurement sets for each test site, calculate the mean concentration for the reference method measurements, using equation 11 of this section:

Equation 11

$$\bar{R}_j = \frac{1}{n} \sum_{i=1}^n R_{i,j}$$

Where:

\bar{R}_j = The mean concentration measured by the reference method for the measurement set;

$R_{i,j}$ = The measurement of reference method sampler i on test day j ; and

n = The number of valid reference method measurements in the measurement set (normally 3).

(3) Any measurement set for which \bar{R}_j does not fall in the acceptable concentration range specified in table C-4 of this subpart is not valid, and the entire measurement set (both reference and candidate method measurements) must be eliminated from further data analysis.

(4) For each of the valid measurement sets at each test site, calculate the mean concentration for the candidate method measurements, using equation 12 of this section. (The outlier test in paragraph (d)(1) of this section shall not be applied to the candidate method measurements.)

Equation 12

$$\bar{C}_j = \frac{1}{m} \sum_{i=1}^m C_{i,j}$$

Where:

\bar{C}_j = The mean concentration measured by the candidate method for the measurement set;

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$C_{i,j}$ = The measurement of the candidate method sampler or analyzer i on test day j ; and

m = The number of valid candidate method measurements in the measurement set (normally 3).

(e) *Test for reference method precision.*

(1) For each of the measurement sets for each site, calculate an estimate for the relative precision of the reference method measurements, RP_j , using equation 13 of this section:

$$RP_j = \frac{1}{R_j} \sqrt{\frac{\sum_{i=1}^n R_{i,j}^2 - \frac{1}{n} \left(\sum_{i=1}^n R_{i,j} \right)^2}{n-1}} \times 100\%$$

(2) For each site, calculate an estimate of reference method relative precision for the site, RP , using the *root mean square* calculation of equation 14 of this section:

$$RP = \sqrt{\frac{1}{J} \sum_{j=1}^J (RP_j)^2}$$

Where, J is the total number of valid measurement sets for the site.

(3) Verify that the estimate for reference method relative precision for the site, RP , is not greater than the value specified for reference method precision in table C-4 of this subpart. A reference method relative precision greater than the value specified in table C-4 of this subpart indicates that quality control for the reference method is inadequate, and corrective measures must be implemented before proceeding with the test.

(f) *Test for candidate method precision.*

(1) For each of the measurement sets, for each site, calculate an estimate for the relative precision of the candidate method measurements, CP_j , using equation 15 of this section:

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Equation 15

$$CP_j = \frac{1}{C_j} \sqrt{\frac{\sum_{i=1}^m C_{i,j}^2 - \frac{1}{m} \left(\sum_{i=1}^m C_{i,j} \right)^2}{m-1}} \times 100\%$$

(2) For each site, calculate an estimate of candidate method relative precision for the site, CP , using the *root mean square* calculation of equation 16 of this section:

Equation 16

$$CP = \sqrt{\frac{1}{J} \sum_{j=1}^J (CP_j)^2}$$

Where, J is the total number of valid measurement sets for the site.

(3) To pass the test for precision, the mean candidate method relative precision at each site must not be greater than the value for candidate method precision specified in table C-4 of this subpart.

(g) *Test for additive and multiplicative bias (comparative slope and intercept).* (1) For each test site, calculate the mean concentration measured by the reference method, \bar{R} , using equation 17 of this section:

Equation 17

$$\bar{R}_j = \frac{1}{J} \sum_{j=1}^J \bar{R}_j$$

(2) For each test site, calculate the mean concentration measured by the candidate method, \bar{C} , using equation 18 of this section:

Equation 18

$$\bar{C} = \frac{1}{J} \sum_{j=1}^J \bar{C}_j$$

(3) For each test site, calculate the linear regression slope and intercept of the mean candidate method measurements (\bar{C}_j) against the mean reference method measurements (\bar{R}_j), using equations 19 and 20 of this section, respectively:

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Equation 19

$$\text{slope} = \frac{\sum_{j=1}^J (\bar{R}_j - \bar{R})(\bar{C}_j - \bar{C})}{\sum_{j=1}^J (\bar{R}_j - \bar{R})^2}$$

Equation 20

$$\text{Intercept} = \bar{C} - \text{slope} \times \bar{R}$$

(4) To pass this test, at each test site:

(i) The slope (calculated to at least 2 decimal places) must be in the interval specified for regression slope in table C-4 of this subpart; and

(ii) The intercept (calculated to at least 2 decimal places) must be in the interval specified for regression intercept in table C-4 of this subpart.

(iii) The slope and intercept limits are illustrated in figures C-2 and C-3 of this subpart.

(h) *Tests for comparison correlation.* (1) For each test site, calculate the (Pearson) correlation coefficient, r (not the

coefficient of determination, r^2), using equation 21 of this section:

Equation 21

$$r = \frac{\sum_{j=1}^J (\bar{R}_j - \bar{R})(\bar{C}_j - \bar{C})}{\sqrt{\sum_{j=1}^J (\bar{R}_j - \bar{R})^2 \sum_{j=1}^J (\bar{C}_j - \bar{C})^2}}$$

(2) For each test site, calculate the concentration coefficient of variation, CCV, using equation 22 of this section:

Equation 22

$$CCV = \frac{1}{\bar{R}} \sqrt{\frac{\sum_{j=1}^J (\bar{R}_j - \bar{R})^2}{J-1}}$$

(3) To pass the test, the correlation coefficient, r, for each test site must not be less than the values, for various values of CCV, specified for correlation in table C-4 of this subpart. These limits are illustrated in figure C-4 of this subpart.

EFFECTIVE DATE NOTE: At 72 FR 32202, June 12, 2007, § 53.35 was amended by revising equation 12 of paragraph (d)(4), equation 13 of paragraph (e)(1), equation 15 of paragraph (f)(1), equation 17 of paragraph (g)(1), and equation 21 of paragraph (h)(1), effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

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(d) * * *

(4) * * *

Equation 12

$$\bar{C}_j = \frac{1}{m} \sum_{i=1}^m C_{i,j}$$

Where:

C_j = The mean concentration measured by the candidate method for the measurement set;

$C_{i,j}$ = The measurement of the candidate method sampler or analyzer i on test day j; and

m = The number of valid candidate method measurements in the measurement set (normally 3).

(e) * * *

(1) * * *

Equation 13

$$RP_j = \frac{1}{R_j} \sqrt{\frac{\sum_{i=1}^n R_{i,j}^2 - \frac{1}{n} \left(\sum_{i=1}^n R_{i,j} \right)^2}{n-1}} \times 100\%$$

* * *

(f) * * *
(1) * * *

Equation 15

$$CP_j = \frac{1}{C_j} \sqrt{\frac{\sum_{i=1}^m C_{i,j}^2 - \frac{1}{m} \left(\sum_{i=1}^m C_{i,j} \right)^2}{m-1}} \times 100\%$$

* * *

(g) * * *
(1) * * *

Equation 17

$$\bar{R} = \frac{1}{J} \sum_{j=1}^J \bar{R}_j$$

* * *

(h) * * *
(1) * * *

Equation 21

$$r = \frac{\sum_{j=1}^J (\bar{R}_j - \bar{R})(\bar{C}_j - \bar{C})}{\sqrt{\sum_{j=1}^J (\bar{R}_j - \bar{R})^2 \sum_{j=1}^J (\bar{C}_j - \bar{C})^2}}$$

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TABLE C-1 TO SUBPART C OF PART 53—TEST CONCENTRATION RANGES, NUMBER OF MEASUREMENTS REQUIRED, AND MAXIMUM DISCREPANCY SPECIFICATION

Pollutant	Concentration range, parts per million	Simultaneous measurements required				Maximum discrepancy specification, parts per million
		1-hr		24-hr		
		First set	Second set	First set	Second set	
Ozone	Low 0.06 to 0.10	5	6	.....	.....	0.02
	Med 0.15 to 0.25	5	6	.....	.....	.03
	High 0.35 to 0.45	4	6	.....	.....	.04
	Total	14	.....	.....	.....	18
Carbon monoxide	Low 7 to 11	5	6	.....	.....	1.5
	Med 20 to 30	5	6	.....	.....	2.0
	High 35 to 45	4	6	.....	.....	3.0
	Total	14	.....	.....	.....	18
Sulfur dioxide	Low 0.02 to 0.05 .....	.....	.....	3	3	0.02
	Med 0.10 to 0.15 .....	.....	.....	2	3	.03
	High 0.30 to 0.50	7	8	2	2	.04
	Total	7	8	7	8	.....
Nitrogen dioxide	Low 0.02 to 0.08 .....	.....	.....	3	3	0.02
	Med 0.10 to 0.20 .....	.....	.....	2	3	.03
	High 0.25 to 0.35 .....	.....	.....	2	2	.03
	Total .....	.....	.....	7	8	.....

EFFECTIVE DATE NOTE: At 72 FR 32203, June 12, 2007, Table C-1 to subpart C of part 53 was revised, effective Sept. 10, 2007. For the con-

venience of the user, the revised text is set forth as follows:

TABLE C-1 TO SUBPART C OF PART 53—TEST CONCENTRATION RANGES, NUMBER OF MEASUREMENTS REQUIRED, AND MAXIMUM DISCREPANCY SPECIFICATION

Pollutant	Concentration range, parts per million	Simultaneous measurements required				Maximum discrepancy specification, parts per million
		1-hr		24-hr		
		First set	Second set	First set	Second set	
Ozone	Low 0.06 to 0.10	5	6	0.02
	Med 0.15 to 0.25	5	6	.03	
	High 0.35 to 0.45	4	604
	Total	14	18			

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Pollutant	Concentration range, parts per million	Simultaneous measurements required				Maximum discrepancy specification, parts per million
		1-hr		24-hr		
		First set	Second set	First set	Second set	
Carbon monoxide	Low 7 to 11	5	6	1.5		
	Med 20 to 30	5	6	.....	.....	2.0
	High 35 to 45	4	6	.....	.....	3.0
	Total	14	18	.....	.....
Sulfur dioxide	Low 0.02 to 0.05 .....	.....	.....	3	3	0.02
	Med 0.10 to 0.15 .....	.....	.....	2	3	.03
	High 0.30 to 0.50	7	8	2	2	.04
	Total	7	8	7	8	
Nitrogen dioxide	Low 0.02 to 0.08	3	3	0.02
	Med 0.10 to 0.20	2	3	.03
	High 0.25 to 0.35	2	2	.03
	Total	7	8

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TABLE C-2 TO SUBPART C OF PART 53—
SEQUENCE OF TEST MEASUREMENTS

Measurement	Concentration range	
	First set	Second set
1	Low	Medium.
2	High	High.
3	Medium	Low.
4	High	High.
5	Low	Medium.
6	Medium	Low.
7	Low	Medium.
8	Medium	Low.
9	High	High.
10	Medium	Low.
11	High	Medium.
12	Low	High.
13	Medium	Medium.
14	Low	High.

Measurement	Concentration range	
	First set	Second set
15	Low.
16	Medium.
17	Low.
18	High.

TABLE C-3 TO SUBPART C OF PART 53—
TEST SPECIFICATIONS FOR PB METHODS

Concentration range, µg/m ³	0.5–4.0
Minimum number of 24-hr measurements.	5
Maximum analytical precision, percent	15
Maximum analytical accuracy, percent	±5
Maximum difference, percent of reference method.	±20

TABLE C-4 TO SUBPART C OF PART 53—TEST SPECIFICATIONS FOR PM_{10} , $PM_{2.5}$ AND $PMR_{10-2.5}$ CANDIDATE EQUIVALENT METHODS

Specification	PM_{10}	$PM_{2.5}$			$PM_{10-2.5}$		
		Class I	Class II	Class III	Class II	Class III	Class III
Acceptable concentration range (R_1), $\mu\text{g}/\text{m}^3$	15–300	3–200	3–200	3–200	3–200	3–200	3–200
Minimum number of test sites	2	1	2	4	2	4	4
Minimum number of candidate method samplers or analyzers per site.	3	3	3 ¹	3 ¹	3 ¹	3 ¹	3 ¹
Number of reference method samplers per site.	3	3	3 ¹	3 ¹	3 ¹	3 ¹	3 ¹
Minimum number of acceptable sample sets per site for PM_{10} methods:							
$R_1 < 60 \mu\text{g}/\text{m}^3$	3						
$R_1 > 60 \mu\text{g}/\text{m}^3$	3						
Total	10						
Minimum number of acceptable sample sets per site for $PM_{2.5}$ and $PM_{10-2.5}$ candidate equivalent methods:							
$R_1 < 30 \mu\text{g}/\text{m}^3$ for 24-hr or $R_1 < 20 \mu\text{g}/\text{m}^3$ for 48-hr samples.		3					
$R_1 > 30 \mu\text{g}/\text{m}^3$ for 24-hr or $R_1 > 20 \mu\text{g}/\text{m}^3$ for 48-hr samples.		3					
Each season		10	23	23	23	23	23
Total, each site		10	23	23	23	23	23
Precision of replicate reference method measurements, P_{R1} or RP_{R1} , respectively; RP for Class II or III $PM_{2.5}$ or $PM_{10-2.5}$, maximum.	5 $\mu\text{g}/\text{m}^3$ or 7%	2 $\mu\text{g}/\text{m}^3$ or 5%	10% ²	10% ²	10% ²	10% ²	10% ²
Precision of $PM_{2.5}$ or $PM_{10-2.5}$ candidate method, CP, each site.			10% ²	15% ²	15% ²	15% ²	15% ²
Slope of regression relationship	1±0.10	1±0.05	1±0.10	1±0.10	1±0.10	1±0.10	1±0.12
Intercept of regression relationship, $\mu\text{g}/\text{m}^3$	0±5	0±1	Between: 13.55–(15.05 × slope), but not less than –1.5; and 16.56–(15.05 × slope), but not more than +1.5.	Between: 15.05–(17.32 × slope), but not less than –2.0; and 15.05–(13.20 × slope), but not more than +2.0.	Between: 62.05–(70.5 × slope), but not less than –3.5; and 78.95–(70.5 × slope), but not more than +3.5.	Between: 70.50–(82.93 × slope), but not less than –7.0; and 70.50–(61.16 × slope), but not more than +7.0.	Between: 70.50–(82.93 × slope), but not less than –7.0; and 70.50–(61.16 × slope), but not more than +7.0.
Correlation of reference method and candidate method measurements.	≥0.97	≥0.97					

¹ Some missing daily measurement values may be permitted; see test procedure.² Calculated as the root mean square over all measurement sets

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EFFECTIVE DATE NOTE: At 72 FR 32203, June 12, 2007, Table C-4 to subpart C of part 53 was revised, effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

TABLE C-4 TO SUBPART C OF PART 53.—TEST SPECIFICATIONS FOR PM_{10} , $PM_{2.5}$ AND
 $PM_{10-2.5}$ CANDIDATE EQUIVALENT METHODS

Specification	PM ₁₀	PM _{2.5}		PM _{10-2.5}	
		Class I	Class II	Class III	Class II
Acceptable concentration range (R _i), µg/m ³	15–300	3–200	3–200	3–200	3–200
Minimum number of test sites	2	1	2	4	4
Minimum number of candidate method samplers or analyzers per site.	3	3	3 ¹	3 ¹	3 ¹
Number of reference method samplers per site.	3	3	3 ¹	3 ¹	3 ¹
Minimum number of acceptable sample sets per site for PM ₁₀ methods:					
R _i < 60 µg/m ³	3				
R _i > 60 µg/m ³	3				
Total	10				
Minimum number of acceptable sample sets per site for PM _{2.5} and PM _{10-2.5} candidate equivalent methods:					
R _i < 30 µg/m ³ for 24-hr or R _i < 20 µg/m ³ for 48-hr samples.	3	3			
R _i > 30 µg/m ³ for 24-hr or R _i > 20 µg/m ³ for 48-hr samples.	3	23	23 (46 for two-season sites)	23	23 (46 for two-season sites)
Each season	10	23	10% ²	10% ²	10% ²
Total, each site	10	23	10% ²	10% ²	10% ²
Precision of replicate reference method measurements, P _R or RP _R , respectively; RP for Class II or III PM _{2.5} or PM _{10-2.5} , maximum.	5 µg/m ³ or 7%	2 µg/m ³ or 5%	15% ²	15% ²	15% ²
Precision of PM _{2.5} or PM _{10-2.5} candidate method, CP, each site.	10% ²	15% ²	15% ²	15% ²	15% ²
Slope of regression relationship.	1 ± 0.10	1 ± 0.05	1 ± 0.10	1 ± 0.10	1 ± 0.10
Intercept of regression relationship, µg/m ³	0 ± 5	0 ± 1	Between: 13.55 – (15.05 × slope), but not less than 1.5; and 16.56 – (15.05 × slope), but not more than +1.5	Between: 15.05 – (17.32 × slope), but not less than 2.0; and 15.05 – (13.20 × slope), but not more than +2.0	Between: 62.05 – (70.5 × slope), but not less than 3.5; and 78.95 – (70.5 × slope), but not more than +3.5
Correlation of reference method and candidate method measurements.	≥ 0.97	≥ 0.97	≥ 0.93—for CCV ≤ 0.4; ≥ 0.85 + 0.2 × CCV—for 0.4 ≤ CCV ≤ 0.5; ≥ 0.95—for CCV ≥ 0.5	≥ 0.93—for CCV ≤ 0.4; ≥ 0.85 + 0.2 × CCV—for 0.4 ≤ CCV ≤ 0.5; ≥ 0.95—for CCV ≥ 0.5	≥ 0.93—for CCV ≤ 0.4; ≥ 0.85 + 0.2 × CCV—for 0.4 ≤ CCV ≤ 0.5; ≥ 0.95—for CCV ≥ 0.5

¹ Some missing daily measurement values may be permitted; see test procedure.² Calculated as the root mean square over all measurement sets.

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TABLE C-5 TO SUBPART C OF PART 53—SUMMARY OF COMPARABILITY FIELD TESTING CAMPAIGN SITE AND SEASONAL REQUIREMENTS FOR CLASS II AND III FEMS FOR $PM_{10-2.5}$ AND $PM_{2.5}$

Candidate method	Test site	A	B	C	D
$PM_{2.5}$	Test site location area.	Los Angeles basin or California Central Valley.	Western city such as Denver, Salt Lake City, or Albuquerque.	Midwestern city	Northeastern or mid-Atlantic city.
	Test site characteristics.	Relatively high $PM_{2.5}$, nitrates, and semi-volatile organic pollutants.	Cold weather, higher elevation, winds, and dust.	Substantial temperature variation, high nitrates, wintertime conditions.	High sulfate and high relative humidity.
	Class III Field test campaigns (Total: 5).	Winter and summer.	Winter only	Winter only	Summer only.
	Class II Field test campaigns (Total: 2).	Site A or B, any season		Site C or D, any season.	
$PM_{10-2.5}$	Test site location area.	Los Angeles basin or California Central Valley.	Western city such as Las Vegas or Phoenix.	Midwestern city	Large city east of the Mississippi River.
	Test site characteristics.	Relatively high $PM_{2.5}$, nitrates, and semi-volatile organic pollutants.	High $PM_{10-2.5}$ to $PM_{2.5}$ ratio, wind-blown dust.	Substantial temperature variation, high nitrates, wintertime conditions.	High sulfate and high relative humidity.
	Class III Field test campaigns (Total: 5).	Winter and summer.	Winter only	Winter only	Summer only.
	Class II Field test campaigns (Total: 2).	Site A or B, any season		Site C or D, any season.	

FIGURE C-1 TO SUBPART C OF PART 53—
SUGGESTED FORMAT FOR REPORTING
TEST RESULTS FOR METHODS FOR
 SO_2 , CO, O_3 , NO_2

Candidate Method _____

Reference Method _____
Applicant _____
First Set Second Set Type
1 Hour 24 Hour

Concentration range		Date	Time	Concentration, ppm		Difference	Table C-1 spec.	Pass or fail
				Candidate	Reference			
Low _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
Medium _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
High _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
							Total Failures:	

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EFFECTIVE DATE NOTE: At 72 FR 32204, June 12, 2007, Figure C–1 to subpart C of part 53 was revised, effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

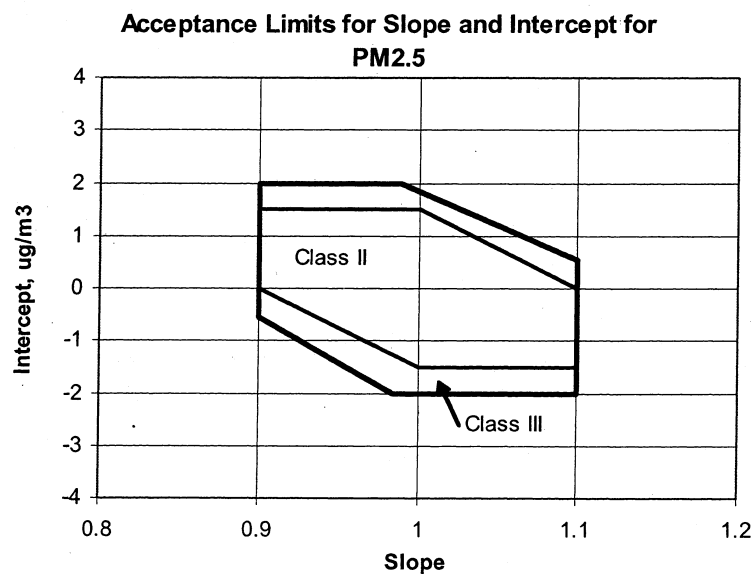
**FIGURE C–1 TO SUBPART C OF PART 53—SUGGESTED FORMAT FOR REPORTING TEST
RESULTS FOR METHODS FOR SO₂, CO, O₃, NO₂**

Candidate Method	_____			
Reference Method	_____			
Applicant	_____			
First Set	Second Set	Type	1 Hour	24 Hour

Concentration range		Date	Time	Concentration, ppm		Difference	Table C-1 spec.	Pass or fail
				Candidate	Reference			
Low _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
Medium _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
High _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
	1							
	2							
	3							
	4							
	5							
	6							
	1							
	2							
	3							
	4							
	5							
	6							
							Total Failures:	

FIGURE C-2 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III PM_{2.5} CANDIDATE EQUIVALENT METHODS

FIGURE C-2 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III PM_{2.5} CANDIDATE EQUIVALENT METHODS.



EFFECTIVE DATE NOTE: At 72 FR 32204, June 12, 2007, Figure C-2 to subpart C of part 53 was revised, effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

FIGURE C-2 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III $PM_{2.5}$ CANDIDATE EQUIVALENT METHODS

FIGURE C-2 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III $PM_{2.5}$ CANDIDATE EQUIVALENT METHODS.

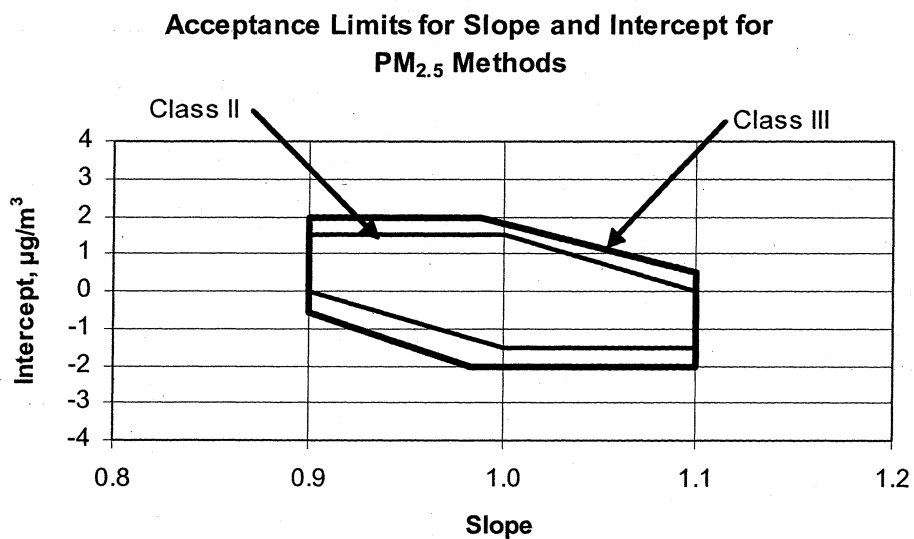
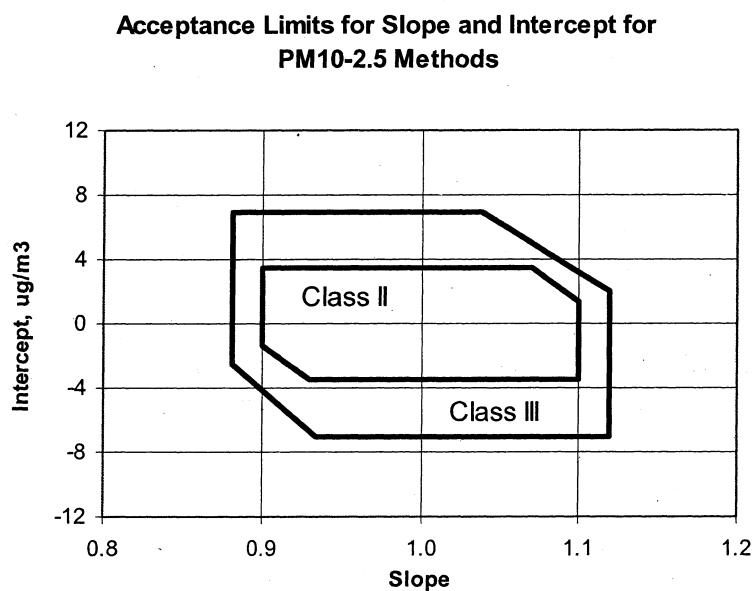


FIGURE C-3 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III $PM_{10-2.5}$ CANDIDATE EQUIVALENT METHODS

FIGURE C-3 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III $PM_{10-2.5}$ CANDIDATE EQUIVALENT METHODS.



EFFECTIVE DATE NOTE: At 72 FR 32204, June 12, 2007, Figure C-3 to subpart C of part 53 was revised, effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

FIGURE C-3 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III $PM_{10-2.5}$ CANDIDATE EQUIVALENT METHODS

FIGURE C-3 TO SUBPART C OF PART 53—ILLUSTRATION OF THE SLOPE AND INTERCEPT LIMITS FOR CLASS II AND CLASS III $PM_{10-2.5}$ CANDIDATE EQUIVALENT METHODS.

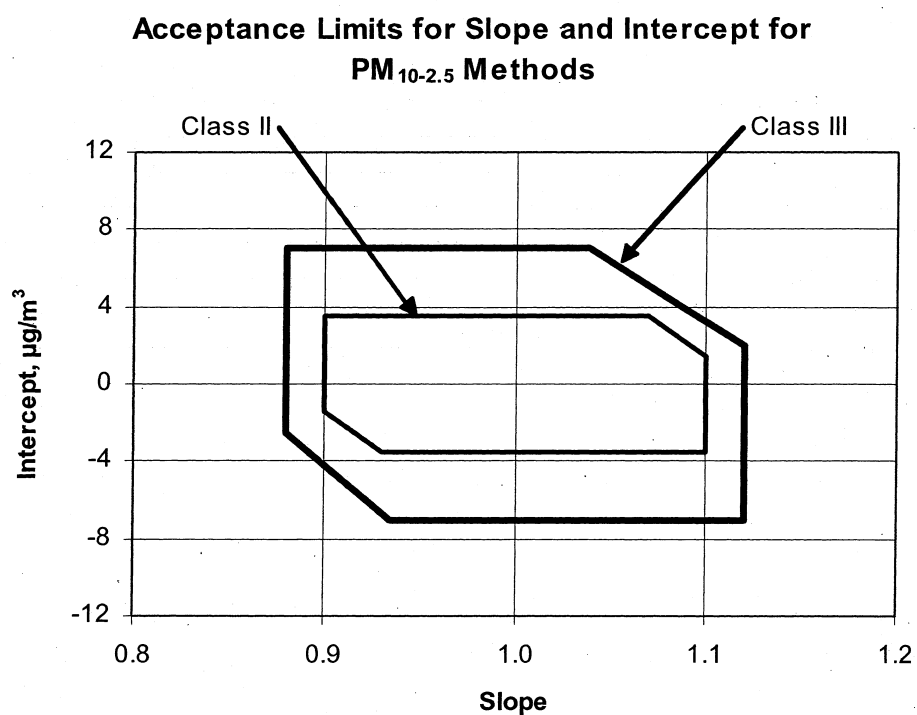
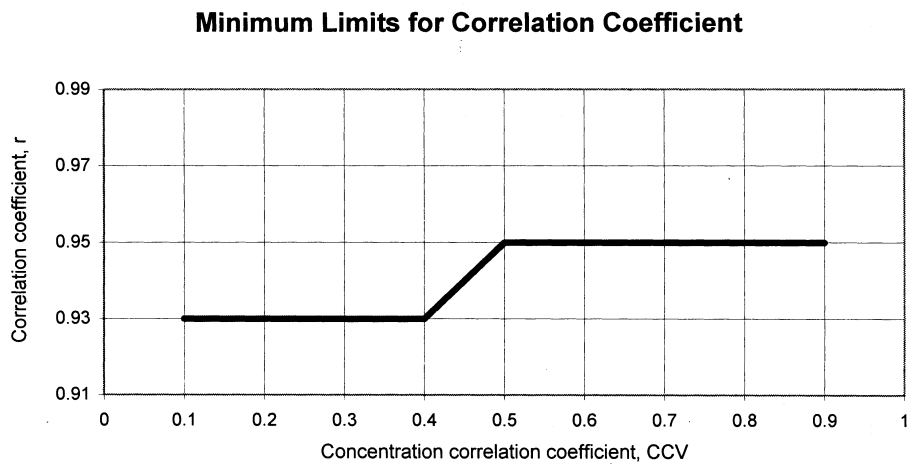


FIGURE C-4 TO SUBPART C OF PART 53—ILLUSTRATION OF THE MINIMUM LIMITS FOR CORRELATION COEFFICIENT FOR $PM_{2.5}$ AND $PM_{10-2.5}$ CLASS II AND III METHODS

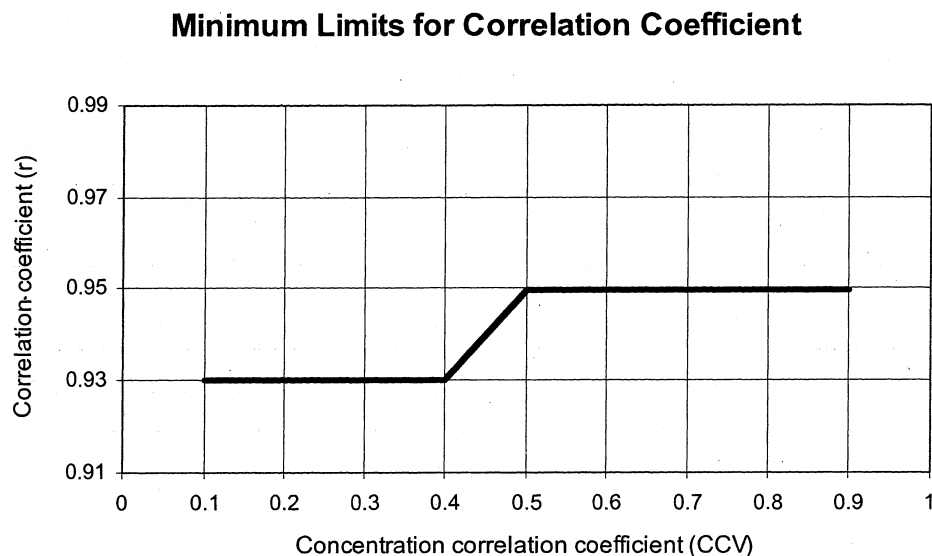
FIGURE C-4 TO SUBPART C OF PART 53—ILLUSTRATION OF THE MINIMUM LIMITS FOR CORRELATION COEFFICIENT FOR $PM_{2.5}$ AND $PM_{10-2.5}$ CLASS II AND III METHODS.



EFFECTIVE DATE NOTE: At 72 FR 32204, June 12, 2007, Figure C-4 to subpart C of part 53 was revised, effective Sept. 10, 2007. For the convenience of the user, the revised text is set forth as follows:

FIGURE C-4 TO SUBPART C OF PART 53—ILLUSTRATION OF THE MINIMUM LIMITS FOR CORRELATION COEFFICIENT FOR $PM_{2.5}$ AND $PM_{10-2.5}$ CLASS II AND III METHODS

FIGURE C-4 TO SUBPART C OF PART 53—ILLUSTRATION OF THE MINIMUM LIMITS FOR CORRELATION COEFFICIENT FOR $PM_{2.5}$ AND $PM_{10-2.5}$ CLASS II AND III METHODS.



APPENDIX A TO SUBPART C OF PART 53— REFERENCES

(1) American National Standard Quality Systems for Environmental Data and Technology Programs—Requirements with guidance for use, ANSI/ASQC E4-2004. Available from American Society for Quality, P.O. Box 3005, Milwaukee, WI 53202 (<http://qualitypress.asq.org>).

(2) Quality Assurance Guidance Document 2.12. Monitoring $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods. U.S. EPA, National Exposure Research Laboratory, Research Triangle Park, NC, November 1998 or later edition. Currently available at <http://www.epa.gov/ttn/amtic/pmqaainf.html>.

Subpart D—Procedures for Testing Performance Characteristics of Methods for PM_{10}

SOURCE: 52 FR 24729, July 1, 1987, unless otherwise noted.

§ 53.40 General provisions.

(a) The test procedures prescribed in this subpart shall be used to test the performance of candidate methods for

PM_{10} against the performance specifications given in table D-1. Except as provided in paragraph (b) of this section, a test sampler or samplers representative of the sampler described in the candidate method must exhibit performance better than, or equal to, the specified value for each performance parameter, to satisfy the requirements of this subpart.

(b) For a candidate method using a PM_{10} sampler previously approved as part of a designated PM_{10} method, only the test for precision need be conducted and passed to satisfy the requirements of this subpart. For a candidate method using a PM_{10} sampler inlet previously approved as part of a designated PM_{10} method, the tests for precision and flow rate stability must be conducted and passed to satisfy the requirements of this subpart; the tests for sampling effectiveness and 50 percent cutpoint need not be conducted if suitable rationale is provided to demonstrate that test results submitted for the previously approved method are applicable to the candidate method.